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It is hoped that this imperfect discussion will open the way for a much fuller discussion, either by way of criticism or enlargement on what has been written.

25. In an investigation in physics Mr. Mason E. Hufford, 525 S. Park Ave., Bloomington, Indiana, has need of the values of the Bessel functions $J_0(x)$ and $J_1(x)$ for positive real values of x up to $x = 100$. Have tables been constructed to this extent? What is the most ready means by which the desired values may be computed to any required degree of accuracy?

Reply by S. A. Corey, Hiteman, Iowa.

Values of Bessel functions $J_0(x)$ and $J_1(x)$ may, for small values of x, be obtained by ordinary methods of quadrature from the definite integrals

$$J_0(x) = \frac{1}{\pi}\int_0^{\pi} \cos(x\cos\phi)\,d\phi,$$

$$J_1(x) = \frac{x}{\pi}\int_0^{\pi} \sin^2\phi\cos(x\cos\phi)d\phi,$$

by taking Δx equal to $\pi/9$, $\pi/12$, $\pi/18$, or for greater accuracy still smaller values.

For larger values of x use the asymptotic series

$$J_0(x) = \sqrt{\frac{2}{\pi x}}\left[\cos\left(\frac{\pi}{4} - x\right)\left\{1 - \frac{1^2\cdot 3^2}{1\cdot 2(8x)^2} + \frac{1^2\cdot 2^2\cdot 3^2}{1\cdot 2\cdot 3\cdot 4(8x)^4}\cdots\right\}\right.$$
$$\left.- \sin\left(\frac{\pi}{4} - x\right)\left\{\frac{1^2}{1\cdot 8x} - \frac{1^2\cdot 3^2\cdot 5^2}{1\cdot 2\cdot 3(8x)^3} + \cdots\right\}\right],$$

$$J_1(x) = \sqrt{\frac{2}{\pi x}}\left[\left\{1 - \frac{(4-1)^2(4-3)^2}{1\cdot 2(8x)^2} + \frac{(4-1)^2(4-3)^2(4-5)^2(4-7)^2}{1\cdot 2\cdot 3\cdot 4(8x)^4} - \cdots\right\}\right.$$
$$\left.\times\cos\left(\frac{3\pi}{4} + x\right) - \left\{\frac{4}{1\cdot 8x} + \frac{(4-1)^2(4-3)^2(4-5)^2}{1\cdot 2\cdot 3(8x)^3} + \cdots\right\}\sin\left(\frac{3\pi}{4} - x\right)\right].$$

These asymptotic series are of such a nature that if we stop the calculations with any term the resulting error is less than the next term. As x increases these series become rapidly convergent, so that any degree of accuracy required in any physical investigation is readily obtainable.

NOTES AND NEWS.

Edited by W. D. Cairns.

"The mathematical analysis of electrical and optical wave-motion" is the title of a book by Dr. Harry Bateman just published by G. P. Putnam's Sons.

Professor H. S. White of Vassar College gave an address on March 5 under the auspices of the Syracuse University chapter of Sigma, his subject being "Mathematics in nineteenth century science."

In *Science* for April 2 President R. S. WOODWARD develops further the differences between his treatment of the deviations of freely falling bodies and the methods of Professor F. R. MOULTON and Professor W. H. ROEVER. (See this MONTHLY of December, 1913, and September, 1914.)

Professor C. W. McCORD, who retired from active service at the Stevens Institute of Technology in 1906, where he had been professor of mechanical drawing since 1871, died in Hoboken, N. J., on April 13, 1915. He was the author of a book on descriptive geometry and was justly honored as the draughtsman who with Captain John Ericsson in 1859 made the plans for the *Monitor*.

Professor R. D. CARMICHAEL, of Indiana University, and Professor ARNOLD DRESDEN, of the University of Wisconsin, will be members of the staff in mathematics at the University of Chicago during the summer quarter, 1915. Professors L. E. DICKSON and H. E. SLAUGHT will be absent on vacation.

DR. DANIEL BUCHANAN, of Queen's University, Kingston, Ontario, has been promoted to an associate professorship in mathematics and has been appointed director of the college observatory.

Professor C. J. KEYSER, of Columbia University, and H. W. TYLER, of the Massachusetts Institute of Technology, will lecture this summer at the University of California, the former on "History and significance of central mathematical ideas and doctrines," the latter on "History of mathematical science."

PROFESSOR H. S. WHITE, of Vassar College, was elected a member of the National Academy of Sciences at the annual meeting held last April in Washington, D. C. The other members representing pure mathematics in this Academy are Professors BÔCHER, BOLZA, DICKSON, MOORE, OSGOOD, STOREY, and VAN VLECK.

MR. GEORGE RUTLEDGE, of the University of Illinois, has accepted an instructorship in mathematics in the Massachusetts Institute of Technology.

At the University of Kansas, Dr. U. G. MITCHELL has been promoted to an associate professorship, and C. H. ASHTON to a professorship in the department of mathematics. Dr. E. B. STOUFFER, who went there last year from the University of Illinois, is an assistant professor in the department.

An article on "The place of the textbook in mathematical teaching" by Mr. EDMUND LIGHTLEY appeared in the *School World* for January.

Professor de Morgan's "Budget of Paradoxes," long since out of print, has been edited by Professor DAVID EUGENE SMITH with extended biographical, historical and explanatory notes. It will appear soon from the press of the Open Court Publishing Company.

The cover for the May issue was dated " April " by an oversight of the printer. The printed slip herewith may be used to correct the error. The next issue of the MONTHLY, will be for September, 1915.